GUJARAT TECHNOLOGICAL UNIVERSITY

Subject Name: Digital Signal Processing
Subject Code: 2170914
B.E. SEMESTER VII

Type of Course: Engineering Science

Prerequisite: Signals and Systems

Rationale: The subject provides in-depth knowledge of the theoretical concepts of the course while the computer based experiments extend better understanding and develop real problem solving skills.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; E- Exam; M- Mid Semester; V- Viva; I- Internal; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment; OEP- Open Ended Problems; ALA- Active Learning Assignments.

Contents:

Sr. No.	Content	Teaching Hours	% Weightage
1.	**Introduction** • Signals, systems and signal processing • Classification of signals • Elements of digital signal processing system • Concept of frequency in continuous and discrete time signals • Periodic Sampling, Frequency domain representation of sampling • General applications of DSP	03	10
2.	**Discrete-Time Signals and Systems:** • Discrete-Time Signals, Discrete-Time Systems • LTI Systems, Properties of LTI Systems • Linear convolution and its properties, Linear Constant Coefficient • Difference equations, Frequency domain representation of Discrete-Time Signals & Systems, Representation of sequences by discrete time Fourier Transform, (DTFT) • Properties of discrete time Fourier Transform, and correlation of signals, Fourier Transform	08	14
3.	**The Z- Transform and Analysis Linear Time-of Invariant System:** • Z-Transform, Properties of ROC for Z-transform, the inverse Z-transform methods	08	20

	• Z- transforms properties, Analysis of LTI systems in time domain and stability considerations. • Frequency response of LTI system, System functions for systems with linear constant-coefficient • Difference equations, Freq. response of rational system functions relationship between magnitude & phase • All pass systems, inverse systems. • Minimum/Maximum phase systems, systems with linear phase.		
4.	**Structures for Discrete Time Systems:** • Block Diagram and signal flow diagram representations of Linear Constant-Coefficient. • Difference equations, Basic Structures of IIR Systems • Transposed forms, Direct and cascade form Structures for FIR Systems, Effects of Co-efficient quantization.	03	7
5.	**Filter Design Techniques:** • Design of Discrete-Time IIR filters from Continuous-Time filters • Approximation by derivatives, Impulse invariance and Bilinear Transformation methods • Design of FIR filters by windowing techniques • Illustrative design examples of IIR and filters.	07	21
6.	**Discrete-Fourier Transform:** • Representation of Periodic sequences: The discrete Fourier Series and its • Properties, Fourier Transform of Periodic Signals, Sampling the Fourier Transform, The Discrete-Fourier Transform, Properties of DFT • Linear Convolution using DFT	04	7
7.	**Fast Fourier Transform:** • Computational complexity of direct Computation of DFT • DIT-FFT algorithm, DIF- FFT algorithm • Comparison between DIT and DIF algorithm	03	7
	DSP Processors: • Introduction to Fixed point Digital Signal Processors • TMS320C2000 series DSP- Architecture, central processing unit, program control, programming issues, system issues, applications • Introduction to floating point Digital Signal Processors	06	14

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (Revised Bloom's Taxonomy)				
Remembrance R Level	**Understanding U Level**	**Application A Level**	**Analyse N Level**	**Evaluate E Level**
20%	30%	20%	10%	20%

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcome:

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

After learning the course the students should be able to:

1. Understands the fundamentals, implementations and application of DSP.
2. Understand applications of z- transforms.
3. Design and analysis of the frequency response of discrete-time signals and systems.
4. Write programs related to various theories.
5. Understand the difference between fixed point and floating point digital signal processor and select them as per requirement of applications.
6. Understand architecture of a TMS320C2000 series digital signal processors.

Reference Books:

1. "Digital Signal Processing: Principles, Algorithm & Application",4th edition, Proakis, Manolakis, Proakis, Manolakis, Pearson
2. "Digital Signal Processing", S.Salivahanan, McGraw Hill Education, 3rd edition
3. "Digital Signal Processing", Tarun Kumar, Oxford University Press
4. "Digital Signal Processors, Architectures, Implementations and Applications" by Sen M. Kuo, Pearson
5. "Digital Signal Processors, Architecture, programming and applications" by B. Venkatramani, M Bhaskar, Mc-Graw Hill

Laboratory Work:

Directions for Laboratory work:

- The list of experiments is given as a sample.
- Minimum 10 experiments should be carried out.
- At least one experiment should be selected from each group.
- Similar laboratory work fulfilling the objectives can also be considered.
- Each experiment should be simulated before verifying practically.
- As far as possible, **printed manual should be preferred** so that students can concentrate in laboratory experiments and related study.

LIST OF EXPERIMENTS:

1. To generate discrete sequence using software tool.
2. To Perform Operation on Sequence using software tool.
3. To represent basic signals (Unit step, unit impulse, ramp, exponential, sine and cosine).
4. To develop program for discrete convolution.
5. To develop program for discrete correlation.
6. To understand stability test.
7. To Perform Z Transform and Inverse Z-Transform and to find Poles, Zeros and gain from a given Z-Transform using software tool.
8. To understand sampling theorem.
9. To design analog filter (low pass, band pass, band stop, high pass filter).
10. To design digital IIR filter (low pass, band pass, band stop, high pass filter).
11. To design FIR filter using windows technique.

12. To write a program to compare direct realization values of IIR filter.
13. To study fixed point and floating point digital signal processors.
14. To study architecture of TMS320C2000 series Digital Signal Processors.

List of Open Source Software/learning website:

1. http://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/
2. http://www.ti.com
3. http://www.dspguru.com/
4. http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/Digi_Sign_Pro/ui/TOC.htm

ACTIVE LEARNING ASSIGNMENTS:

Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work. The faculty may allocate chapters or part of chapters to groups of students so that the entire syllabus to be covered. The power-point slides may be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide.